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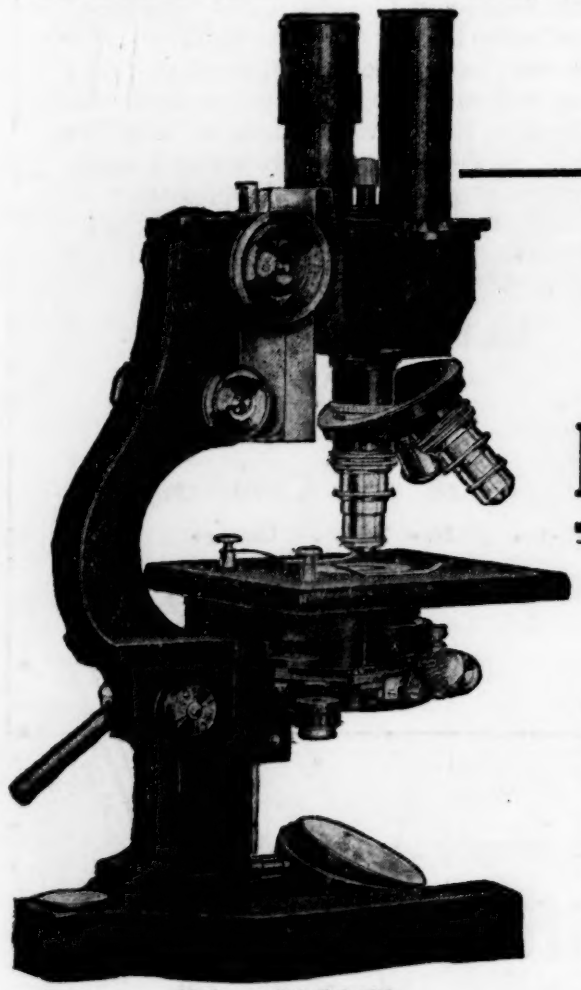

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FRIDAY, JUNE 22, 1917

CONTENTS

The Sources of Nervous Activity: PROFESSOR G. H. PARKER 619

An Address to the Graduating Class of the Harvard Medical School: PROFESSOR W. T. COUNCILMAN 626

National Service on the Part of Zoologists and Zoological Laboratories 627

Scientific Events:—

Suspension of the Kew Bulletin; Daylight Saving; The Smithsonian Station for the Study of Solar Radiation; The Aquarium of the California Academy of Sciences 630

Scientific Notes and News 632

University and Educational News 635

Discussion and Correspondence:—

An Institute for the History of Science: BERT RUSSELL. *A Cure for Shock?* G. V. N. D. 635

Scientific Books:—

Howard, Dyar and Knab on the Mosquitoes of North and Central America: PROFESSOR T. D. A. COCKERELL 637

Notes on Meteorology and Climatology: DR. CHARLES F. BROOKS 639

Special Articles:—

The Distribution of Endemic Species in New Zealand: PROFESSOR HUGO DE VRIES. 641

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THE SOURCES OF NERVOUS ACTIVITY[1]

I CAN not proceed with what I have to say without speaking first a word of congratulation and thanks to those whose material and intellectual resources have made the Scripps Institution for Biological Research an actuality. Biologists the world over are coming to be more and more dependent for their training and inspiration upon just such establishments as this. The introduction into our institutions of learning of the laboratory with its unique and novel educational methods was indeed a vast step in modern progress, but it can be said in no sense to have rendered superfluous the laboratory designed for pure research. This, from the time of Davy and Faraday, has retained its original function unimpaired and has been the means of directing mankind to many of his most profittable lines of endeavor. Such research institutions, which by a happy concurrence of events have been much on the increase of recent years, must always remain the highest shrines of science. They originate, they conserve, they hand on; and all this is done without the interference of the pedagogue; in other words, their scholarship, to use that term in its best sense, is of the highest order. In them the true spirit of science is better exemplified than in any other type of institution that we possess. It is therefore a time for congratulation when the Scripps Laboratory can open its doors more widely than ever before to those who have reason to make use of its abundance.

It has been in such institutions as this

[1] A dedicatory address delivered August 9, 1916, at the Scripps Institution for Biological Research of the University of California.

that in the past few years I have been conducting studies on the origin of that most intricate and complex systems of organs, the nervous system, and in fact it is to this institution that I have come for a time to continue such investigations. It may not be inappropriate, therefore, if I attempt to tell you in as simple and direct a way as I can something of the problem on which I have been working and of the results that I believe I have attained.

Every one knows nowadays that there is an intimate and important relation between man's intelligence and his brain, that his eyes, ears and other sense organs deliver to him information concerning the exterior, and that by means of his muscles controlled through his nerves, he can mold his surroundings more or less to his liking. But perhaps few persons have realized how strictly nervous all these operations really are. Take, for instance, the apparently simple question of the seat of our sensations. To an untrained person the pain of a pin prick is located where the pin enters his skin. To him nothing seems more obvious and certain than that the punctured spot is the seat of the pain and any attempt to change his view on this point will usually be regarded by him with suspicion and mistrust, for it seems contrary to common sense. Such persons adopt more or less unconsciously the opinion held by many of the ancients that our sensations are spread completely through our bodies, an opinion which we have been obliged to give up. The reasons for this change of view are several. First, it has become well known that, if a nerve distributed to a given area of skin is cut at some distance from that area, the spot, though unaffected in any direct way by the operation, will give rise to no further sensations even when it is severely stimulated. Hence it is clear that the sensations do not reside simply in the skin. But not only may pain thus be absent from a given area of skin; it may be present when the skin with which it is supposed to be associated is absent. Persons who by accident or otherwise have lost an arm or a leg often experience long after the loss vivid and intense sensations from definite parts of the missing member. So precise and sharp are these sensations and so certainly do they seem to be associated with the lost part that some of the less knowing of these unfortunates have attempted to exhume or otherwise get possession of the lost member in an endeavor to alleviate their unpleasant sensations. These misunderstandings, for such they are, can be swept away and the matter put in its true light when we recognize that our sensations are not located in the peripheral parts affected but in the central nervous system, and within that portion of it known as the cerebral cortex. As long as this organ is intact, sensations may arise, and, though these are usually due to nervous impulses from the sense organs, they may be called forth by an internal stimulus as well. Thus it is that a missing arm may be represented by sensations years after it has been severed from the body. With a loss of an appropriate part of the cerebral cortex, however, comes a loss of sensation that is absolute and final. From this there is no recovery. Our sensations then are not spread throughout our bodies, as was taught in ancient times but are limited strictly to the nervous system and in all probability to that part known as the cerebral cortex.

Not only are our sensations thus activities of the cortical part of the brain, but there is good reason for believing that our whole conscious life is similarly restricted. In the cerebral cortex lies memory with its wealth of stored experiences, in this organ love, hate and fear come into being; here

arise the cool deliberations of the man of science, the dreams and aspirations of the poet, the passion of the religious enthusiast, and, when abnormalities intervene, the ravings of the madman. Contrary to ancient belief, the spleen does not engender temper, nor do the affections flow from the heart. These and all other like attributes proceed from the brain. And yet the old traditions have so strong a hold upon us that I doubt whether any modern suitor would forward his cause by offering to the lady of his choice the real organ of his affection, his cerebral cortex, rather than his heart.

Accepting the modern view that the conscious life of man is not a function of his body as a whole but an activity limited strictly to his nervous system, it follows that the evolution of this system becomes a question of special interest. In man and the other higher animals this system consists of a most intricate collection of transmitting fibers, end-stations, centers and the like so disposed as to receive and record the influx of surrounding changes and to respond to these by appropriate movements. The light of a friendly countenance reaches us through the eye and a word of salutation through the ear and off comes the hat in response. When we scrutinize more closely the machinery of these operations, we find it simple in outline, though inconceivably intricate in detail. There are first of all the sense organs of the body, the eyes, ears, nose, mouth and so forth each attuned to a particular set of influences or stimuli and each delivering to the central organs evidences of the momentary states of these stimuli in the exterior. Next are the central organs, the brain, spinal cord and the like, parts that receive the flood of sensory information from the outer world and pass it on unnoticed or store some remnant of it as a part of life's experience. Last of all are the voluntary muscles set in action by impulses from the central apparatus and capable of performing the thousand acts good or ill that make us the responsible beings that we are. These in gross outline are the three great categories of our nervous machinery, or better, of our neuromuscular machinery, for muscles are necessarily an integral part of this chain. When such a chain goes into action, sense organ, central nervous organ and muscle, we speak of this as a reflex, for it resembles light in that it passes from an external source inward to a central organ whence it is reflected, so to speak, outward to the muscle.

If we examine the nervous systems of animals lower than man, we find in them the same three categories of parts. All the vertebrates from the mammals to the fishes have sense organs, central nervous organs and muscles. The same is true of the snails, the clams, the insects, the crabs and many others. Even the worms possess these three classes of organs, though with less differentiation as a rule than in the higher animals.

But, when we study the jelly fishes, the sea anemones, or hydroids, the case is different. Here we meet with an obvious simplification and what is noteworthy is that all three parts are not equally reduced, but that one, namely, the central organ, has suffered almost complete obliteration. In these lowly creatures the sense organs, either in the definite form of eye spots and the like, or as broad receptive surfaces without great specialization, are superimposed almost directly upon the more deeply seated muscles. Such animals often have not even a trace of an intervening nervous organ that could be called a central organ. The sense organs may thus connect directly with the muscles. Obviously under these circumstances the sense organs lack entirely that function that they showed in so marked a degree in the higher animal,

namely, the supply to the central organs of information, so to speak, as to environmental changes. In these more simplified conditions they must be restricted to the simple process of exciting the muscles to activity in consequence of special forms of sensory stimulation. They act, in other words, as a series of local triggers to set off muscular activity in various parts of the body as needed. Here then we see a stage in the evolution of the nervous system in which the sense organ and the muscle are the essential parts, but the central organ is to all intents and purposes omitted. Obviously, this stage must precede that in which central organs are present and these organs, brain, spinal cord and the like, must be looked upon as of later racial origin than sense organs and muscles. It may at first sight seem strange that so significant and all-important an organ as the brain should have been evolved secondarily in relation to sense organs, but such seems to be the case and we are justified, I believe, in stating that animals possess a brain in consequence of their having previously had sense organs, not that they possess sense organs because they have a brain.

The absence of a central organ and the presence merely of sense organs and muscles in sea anemones and other like forms makes itself felt in the activities of these animals. As I have already pointed out, that feature above all others that makes one of the higher animals, and especially man, a unit, is the possession of mental traits. Our conscious life affords our strongest claim to individuality. When this is disturbed, as in cases of double personality or in the various forms of insanity, even so practical a matter as the law takes cognizance and we treat such individuals differently from the common run of men. This unifying influence of the nervous system, technically spoken of as its integrative action, is almost completely absent from such animals as the jelly fish and sea anemones. With them individuality is a very subordinate character, and it is questionable whether they possess any trace whatever of that trait which we denominate personality in ourselves. They possess no single organ to which the nervous experience of their various parts may be referred to the advantage of the whole. Hence such nervous organization as they have is appropriately styled diffuse, in contrast with the centralized condition of higher forms.

The significance of this state of affairs is well seen in the activities of sea anemones. Many years ago it was shown that, if a single tentacle is snipped from the mouth region of a sea anemone and held in seawater so that the observer can recall which side of the tentacle was originally turned toward the mouth of the animal, the tentacle will be found to entangle food and to twist itself in a direction that would be appropriate for the delivery of the food to the mouth were that aperture still in its original relation with the tentacle. This response, which has been repeatedly confirmed by others, including myself, shows that each tentacle contains within itself the necessary nerve and muscle to carry out its own movements, and that it is not dependent, as in the case of the arms, legs, jaws and so forth of the higher animals, upon a distantly located central nervous organ to initiate, control and subdue its movements. In a similar way I have recently shown that the pedal disc with which many sea anemones creep about will, in certain species, carry out perfectly normal locomotor movements even after the other half of the animal, including the mouth and tentacles, has been cut away. This instance also demonstrates the neuromuscular adequacy of the part of the animal concerned and its relative independence of the rest. Auton-

omy of parts, then, is one of the most striking aspects of the neuromuscular organization of the sea anemones and is strong evidence in favor of the absence of a centralized nervous organ in these animals. The same conclusion can be drawn from certain aspects of the feeding habits of sea anemones. If one of these animals is persistently but slowly fed by the tentacles on one side of its mouth, it will sooner or later cease to take food by these tentacles, though the muscles of the tentacles are in no sense fatigued. If food is now applied to the tentacles on the opposite side of the mouth, feeding will recommence almost as though the animal had not been fed previously. Thus the change of response induced on one side of the mouth has had little or no effect on the other, a condition referable to the absence of a central nervous organ. It is thus evident how different the organization and the responses of an animal without a central nervous organ are as compared with those of forms possessing such an organ.

Sense organs and muscles may therefore be regarded as two elements more primitive than the central nervous organs in the evolution of the neuromuscular mechanism. What is the source of these two parts? Did they arise together, twins at a single birth, or is one the older, and, if so, which? Kleinenberg in his theory of the neuromuscular cell, and the Hertwigs in their account of the nervous system of sea anemones, were both led to declare in favor of the simultaneous and dependent origin of nerve and muscle. Claus believed that these two elements arose independently and came together secondarily, a view subsequently espoused by Chun. When, however, animals more primitive than sea anemones, such, for instance, as sponges, are studied, a different solution to the problem from those just suggested is obtained. These lowly forms as mature animals possess no powers of locomotion whatever and the few movements that their bodies exhibit are carried out with the utmost deliberation and slowness. They can very slightly and always with great slowness bend and unbend their bodies as a whole, and they can close and open the numerous inlets and the few outlets by which the spaces within their substance are set into communication with the surrounding water. All these movements are carried out by a very simple form of muscular tissue and so far as concerns the study of their bodies, both anatomical and physiological, there is no evidence whatever of the presence of sense organs or other forms of nervous tissue. It therefore seems quite certain that in sponges we have primitive animals possessed of muscle but devoid of nerve even in the form of sense organs, and we may therefore conclude that, between muscle and sense organs, the muscle is of more ancient origin and marks the beginnings of that series of functionally related parts that culminates in the central nervous systems of the higher animals.

These views as to the steps in the evolution of the nervous system, as to the sources of our nervous structures and activities, have already found expression. They carry with them, however, certain implications concerning the manner in which we should frame our hypotheses as to the springs of nervous action, implications that have not been so generally appreciated. In the early part of this address I sketched the commonly accepted view of the organization of nerve and muscle in the higher animals. From the standpoint of human interests the sense organ is the avenue through which we gather in the course of our lives that enormous body of information concerning our surroundings. By smell, taste and touch we gain a knowledge of the more elemen-

tary chemical and physical aspects of the environment. Touch, moreover, gives us form and position and passes imperceptibly into that vague but enormously important sense, the muscle sense, through which the movements of our bodies, our limbs and other parts are checked and adjusted and the whole problem of spatial relations receives a new setting. Closely allied to these senses is the ear as an organ of equilibration responding to the pull of gravity and to our sudden changes in position and, like the muscle sense, affecting our conscious states so slightly that we scarcely know we have such a sense till on sea or on train excessive stimulation due to the unusual form of motion draws on characteristic discomforts. Next may be mentioned the ear as an organ of hearing attuned to the sounds of nature and in man attentive to the voice, that marvelous means of signaling whereby the momentary mental life of one human being can be quickly and accurately imposed upon another. And finally the eye with its responsiveness to light three thousand times greater than that of the most sensitive photographic plate, adjusted to color and to form, and in no whit behind the ear in its social significance. Thus our sense organs literally deluge us with a flood of messages concerning our surroundings and yield us all the elements out of which our mental life is built. In fact there is good reason to believe that without this sensory inrush consciousness itself could never come into being. The newborn brain is not unlike the western desert; only after irrigation in the form of sensory inflow does consciousness begin to blossom.

Considering the enormous significance of the sense organs for man as the means of supplying him with the content of his mind, it is not surprising that in attacking the problem of the brain and our mental states students should have made their approach almost entirely from the sensory side. The quality and quantity of sensations were exhaustively investigated and even the central nervous organs were dealt with from the standpoint of their sensory relations. In brief, the sensation became more and more the established unit in considering nervous action, and we were led to interpret the nervous states of the whole range of lower animals by the sense organs they were shown to possess. If a particular worm or jelly fish had an unusually developed eye, it was assumed that the given animal enjoyed an excess of sensation akin to sight with us as compared with its less fortunate neighbors. If a crawfish inhabiting caves possessed degenerate eyes, but was covered with enormously developed tactile hairs, it was supposed to have realized something of that excessive development of touch which we know is characteristic of the human blind. Thus the well-known relations of our sense organs to our mental life gave a basis for the assumption of corresponding mental states in the lower animals.

If, however, the sources of our nervous organs are such as I have sketched, it is extremely doubtful whether the interpretations just mentioned are at all justifiable. In the beginning sense organs had nothing whatever to do with the delivery of messages to a conscious center. They were organs concerned merely with the calling forth of muscular movements. The animal with especially developed eyes or with unusual organs of touch is not necessarily endowed with special sensations in these directions; it may be an animal merely adapted to respond with unusual delicacy to light or touch and without central nervous relations at all. Thus the sense organs in the lower animals come to have a very different significance from that formerly attributed to them. They are special means

of exciting action rather than organs of an informing nature. It must also not be forgotten that though the sense organs of the higher animals are in many cases primarily organs of information, so to speak, they probably all still retain their original function of exciting muscles, at least indirectly, to action. They are the beginnings of practically all reflex arcs. Not only is this true, but not a few of them retain, so far as our conscious life is concerned, much of that hidden and submerged state that characterizes them in the lower animals. They lie in their activities below the conscious and even the subconscious level. This can be exemplified in one of the senses already named, the muscle sense. We are almost continuously cognizant of light, noise, smell and so forth, but we find it almost impossible to realize in our conscious states sensations from the muscle sense. Obscure, vague and indefinite, they impress us scarcely at all. Only here and there do they appear to rise into the region of strong sensation. Within the last few years it has been shown that the sensation of hunger is dependent upon stomach movements. Each hunger pang is due to a wave of muscular contraction passing over the walls of the stomach. It is, therefore, not improbable that the hunger pang is a muscle sensation that, from its organic importance, has lifted itself from the low level of unconscious activity into the higher strata of our conscious states.

The great majority of the sense organs of the lower animals are concerned with yielding impulses to motion that are in no way associated with consciousness, and this is undoubtedly their primitive function. Such animals often exhibit complicated systems of transmission tracts connecting their sense organs with their muscles, and these tracts collectively mark the beginning of a central nervous system. It is probable that a sensory equipment of this kind, with the well-established beginnings of a central apparatus, afforded the necessary settings for the appearance of consciousness, which thus found roughed out by the earlier necessities of the organism a system of sensory and central components capable of sustaining future growth. At this stage the sense organ must have added to its primitive function of calling forth muscle activity that of supplying messages to a growing central organ, a function that has become of such paramount importance in man.

If this outline of the sources of our nervous activity is true, it follows that any conception of the nervous system that assumes sensation as a basal phenomenon is most assuredly to be abandoned. Sensations are associated with only the later phases of nervous development. The feature that has been present throughout the whole period of this evolution is muscular activity. In fact, as I have already stated, we have reason to believe that muscular activity preceded nervous origins and that nervous tissue appeared in consequence of the presence of muscles. Our own sensations, then, are not our most fundamental and primitive nervous processes, but behind these and of much more ancient lineage are our impulses to action, our wishes, our desires, and the whole vague body of nervous states that drive us to do things. These are the most ancient and deeply seated of our nervous propensities, and immeasurably antedate in point of origin, our sensations with all that supergrowth that constitutes the fabric of our mental life. We do well to warn ourselves to think before we act. Action is the oldest and most ingrained of our nervous functions, thinking the newest.

You will pardon me if I have led you from the realm of simple fact and observation far afield into that of pure speculation, for the general scheme of the sources of our nervous action that I have outlined must be

regarded as largely speculative. Such outlines are, however, suggestive of the myriads of questions that science attempts to answer. And the answers, when found, are the means of correcting these outlines that they may coincide more nearly with the truth. It is to the attainment of this general truth that establishments such as the Scripps Institution are dedicated. May the increased facilities that we celebrate to-day yield an ample and worthy return.

G. H. Parker

Harvard University

A SHORT ADDRESS TO THE GRADUATING CLASS OF THE HARVARD MEDICAL SCHOOL, 1917

It is on occasions such as this, at certain eras in the lives of young men, that we compel them to listen to words of counsel, however this ultimate end of giving counsel may be concealed in verbiage. Older men, in which class I have been rather reluctantly compelled to put myself, are generally selected to give utterance to these words, from the fact that, having had a wider experience, their views will have a greater importance, and indeed many of them and even their hearers really believe this. It must be said that there is no demand for this on your part and these addresses, like lectures, are forced upon you; at least I do not think you would rise up and clamor for them, but you passively submit.

If one looks over the literature of addresses—and the sum of the published ones would almost fill the Alexandrian Library—there is great similarity in the matter and in the form of presentation. In recent years there has been some decline in attempts at eloquence and you are no longer told that medicine is a useful and noble profession, with citation of examples, or that you are a vessel embarking on the sea of life, this associated with descriptions of lighthouses, cross currents, storms, etc. I speak feelingly, for on looking over some old addresses of mine I found that I also had once spoken of ships and storms and lighthouses, and I should like to humbly apologize to my former auditors.

This desire of ours to talk is partly due to the garrulousness of age, which is compelled to substitute words for action, and having found how much easier the process is, and how pleasant, indulges itself in the vice; and partly to the persistence of an utterly mistaken view of education. The idea that education, that process which aims at the development of the individual with the view that he shall be capable of greater service and of greater individual happiness, can be attained by telling the aspiring student things or having him study merely the product that others have wrought, has unfortunately not entirely passed. If I have learned anything in my now somewhat long life as a teacher it is that the process of education consists in giving the student opportunity, the material to study, be it mankind, books, ants or dead bodies, and in every way assisting him in the study, always recollecting that the result must be individual, the product of the material which his brain has received, digested and assimilated. We must not think that we can give him in words merely the conceptions which we have arrived at, although he may derive some profit by comparing our concepts with his own.

We should not think that in an address we can give a young man any thing of real value. What we are depends upon the individuality of our living material and the result of the action upon this of the special matter which education gives plus the more generalized influences of the environment. It is particularly now, when such enormous changes in environmental conditions, as compared with those under which

we have lived, exist and are in process of creation, that the futility of attempts to force our views upon you must be apparent. As I see the great struggle now it is not only between democracy and imperialism, but underlying this a still greater struggle between socialism and individualism. This is apparent in medicine as it is in every other domain of life and what will be the outcome no man can say. The currents in the sea are so vast in extent and power, the winds so variable, that there is the temptation to merely stand aloof and be swept along. I think I can advise you, reluctant as I am to attempt advice, to resist this; plunge in and struggle for what seems to you the right, remembering that general conditions of social environment depend upon the actions of individuals and it is you who are the creative force—on you rests the responsibility.

With this as a preamble it would give me great pleasure to pursue the subject further, for I really like to talk, and as I look around and see you I recall many happy hours which are associated with you and I am grateful to you for having given me this happiness. But fortunately for us all time passes, changes, it is now gone, and I have been spared the chance of giving you opinions which are probably erroneous and possibly productive of injury.

I think, however, it is only right that I should tell you that addresses may have a great importance and even determine future events, as the following example shows. Some time ago I happened to be in the capital of a Brazilian state just after a gubernatorial election. There had been the usual phenomena which such an event in a Brazilian city produces. Some fifty people killed, three times as many wounded, a newspaper office blown up and on numerous houses the peculiar pits made by the modern jacketed bullet. At the time I reached there, two weeks after the inauguration, everything was going on as usual. It seems that full arrangements were made to blow up the governor on his way home after the inaugural address. But the importance of the address had not been properly considered. The governor spoke long, giving the history of the country from its discovery, the modern conditions and the hopes of the future. The matter was dull, hours which seemed like weeks and minutes which seemed like days passed and he continued to speak without the audience being able to see any hope of cessation. The conspirators were nervous, the exciting events had deprived many of them of their wonted calm siestas, and under the soothing influence of the orator many slept; others were not able to endure the absence of alcohol for so long a period and these departed to look for it; for others so long a period of silence on their part could not be endured and these departed to gather up an audience; others felt they might be missed at home and these sought the presence of the household gods. In short the conspiracy was broken up, the audience gradually departed with the taxis which were to have formed the procession, and the governor was finally left speaking to a single close friend who went home with him by a back way, and the country for a time was saved. The party newspapers which printed the speech said it was a masterly effort; the opposition was silent, for their newspaper had been blown up.

W. T. COUNCILMAN
HARVARD UNIVERSITY

SOME SUGGESTIONS FOR NATIONAL SERVICE ON THE PART OF ZOOLOGISTS AND ZOOLOGICAL LABORATORIES

IN an article in the *New Republic* for March 31 last entitled "America Prepares" William Hard pokes fun at the enthusiasm for organization which has taken possession of the coun-

try; the National Research Council receives its share of serio-comic attention and as a climax of the ridiculous and absurd there is mentioned the Committee on Zoology and Animal Morphology. "I doubt," he says, "if any other nation ever responded to the prospect of war with a scheme of national defense which included a Committee on Zoology and Animal Morphology."

It should not be forgotten that the establishment of the National Research Council antedated the declaration of war by a whole year and that one of its chief functions was and is the promotion of research in all branches of science in the belief that human progress depends upon increasing knowledge of nature and that national welfare can be advanced most effectively by the cooperation of scientific investigators.

With the country at war it is but natural that the activities of the Research Council should be directed primarily to problems connected with the war and patriotic men and women in all branches of science, as well as in every other occupation, are asking how they may best serve the nation in this crisis. Zoologists, no less than others, are asking this question and it is with a view to answering it in a general way that the Committee on Zoology of the National Research Council has drawn up the following suggestions.

To the zoologists no less than to the *New Republic* it is evident that this science is only indirectly and remotely related to war—indeed it has been claimed that hitherto the biological sciences are the only ones which have not been used for the destruction of human life. The greatest national service which the biological sciences can render in war as well as in peace is in conserving human life, and also in protecting and improving useful animals and plants and in controlling or destroying injurious ones; when it is remembered that practically everything which we eat or wear comes from animals or plants it will be realized that this is no slight service.

Many of the practical and economic branches of biology have long been well organized for such service and this applies particularly to medicine, sanitation and agriculture, but in each and all of these branches the trained zoologist may render valuable aid. Probably no other scientific men are better prepared by training and no other institutions better fitted by equipment to assist in medical and sanitary work than are zoologists and zoological laboratories, and in the matter of the propagation and improvement of useful animals and the destruction of useless or injurious ones the zoologist should be especially at home. In many instances zoologists who have hitherto confined their attention to theoretical and general problems would need to turn their attention to new lines of work, but it can not be doubted that practise in solving general and theoretical problems would be of great value in dealing with specific and practical ones.

I. SANITARY WORK

1. Much sanitary work is primarily zoological as, for instance, the study of the life histories of parasitic protozoa, tapeworms, flukes, roundworms, insects, mites, etc., together with methods of their control or eradication.

2. The elimination or control of animal carriers of disease-germs, such as flies, mosquitoes, bugs, fleas, lice, rats, etc.

3. Assistance in medical diagnosis, as in the microscopical or chemical examination of blood, urine, feces, sputum, etc.

4. Microscopical or chemical examination of water and soil of camp sites, drainage areas of cities, etc.

5. The zoological aspects of the collection and disposal of garbage and sewage.

In view of the importance of zoological science in dealing with old and new problems which will arise in connection with sanitation it would be very desirable to have at least one trained zoologist connected with the medical staff of each mobilization camp.

II. AGRICULTURAL WORK

1. Cooperation with the agricultural agencies of the states and nation in the elimination of animals which prey upon or are parasitic upon domestic animals; of animal pests destructive to crops, fruits, forests, to stored vegetables, grain and other food supplies, to

clothing, woodwork and other manufactured products.

2. Application of principles of heredity to the improvement of breeds of domestic animals.

3. Study of physiology of reproduction with a view to increasing productivity in animal breeding; for example, improved methods of incubation, brooding and rearing of fowls.

4. Determination of standards of feeding and nurture of domestic animals for best general or specific results and for greater economy.

III. EXTENSION OF FOOD SUPPLY

1. Preservation, propagation and domestication of useful wild animals. Probably certain useful birds and mammals, now wild, might be domesticated; others not native might be imported under proper precautions.

2. The protection of birds which are beneficial to agriculture. It is estimated that in Kansas alone the annual preventable damage to food crops amounts to thirty million dollars. The largest natural elements in the prevention of this loss are ground-nesting birds. Migratory birds should be protected by the passage of the House of Representatives Bill No. 2612, known as the "Migratory Bird Treaty Act."

3. Exploitation and propagation of useful marine and fresh-water animals, in cooperation with the Bureau of Fisheries. There is an unlimited supply of food in the oceans of the world and we have scarcely begun to reap the "harvest of the seas." Countless forms of fishes, crustacea, mollusks and other types which are not now generally used as food are both wholesome and delicious when properly prepared. The Commissioner of Fisheries says:

> Zoologists may perform a service by bringing to the attention of people, in the course of their conversations, lectures, etc., the reasons for looking to the fisheries for increased food supply, the wholesome character of the meat, the economy with which fish are produced without dependence upon agriculture for their food. Many new fishes are being introduced into the market—sharks, bowfin, burbot, sable-fish and others, and it is certain that zoologists can do a good service in helping to overcome popular inertia that will be encountered. The Bureau will gladly send circulars announcing new fishes to any who apply.
>
> The biological problems of fish ponds are numerous. Recently a college zoologist in association with the Bureau began giving special attention to the relation of dragon flies and damsel flies to fish culture in ponds. Already he has gained results that were unexpected, but that are highly significant. The larvæ of dragon flies were known to prey upon fish fry, but this investigator, Professor C. B. Wilson, finds that they also prey in greater measure upon other insects that are more effective enemies of fish fry; various other interesting interrelations are discovered This is only an illustration of what may be done with various groups of aquatic and semi-aquatic animals and plants. Results of value may, in some cases, be obtainable in a brief space of time.
>
> We know very little about the parasites of fishes, their relative abundance under different conditions of environment, their life-histories and alternate hosts. Means of control can not be devised without more complete knowledge regarding particular species.
>
> We should be glad to advise either directly or through you with any zoologist who is considering a particular problem related to the fisheries.

IV. EDUCATIONAL AND SOCIAL WORK

1. Thorough studies of human heredity as a necessary preliminary to any attempt to permanently improve our human stock and increase national efficiency.

2. The teaching of zoology, as well as of other sciences, may be made a very important means of promoting national intelligence, cooperation and welfare.

3. While the great demands on medical men last, zoologists would be well qualified to assist in medical education, especially in histology, embryology and neurology.

4. The prosecution of research work, whether in pure or applied science, is a national duty of the first magnitude; the continuance of research work by zoologists, and especially work already begun which can not be interrupted without serious loss to science, is a real national service.

V. MISCELLANEOUS PROBLEMS

In addition to these general lines of work the following special problems have been suggested:

1. The microscopical inspection of food, clothing and supplies.

2. Studies of the coat coverings of animals with a view to the utilization of nature's principles in making the clothing of soldiers light, warm, well ventilated, impervious to water and protectively colored.

3. Studies of the mechanism of aquatic and aërial locomotion in animals with reference to its application to submarines and aëroplanes.

4. Utilization of gulls and other aquatic birds in locating submarines.

5. Studies of the mechanisms of limbs and joints with a view to offering suggestions in the construction of artificial limbs.

6. Investigations in tissue cultures, grafting and regeneration, with a view to their surgical applications.

The committee would welcome any further suggestions either in the line of additional problems or of practical methods of attacking those named.

E. G. Conklin, *Chairman*,
Princeton University,
S. A. Forbes,
University of Illinois,
C. A. Kofoid,
University of California,
F. R. Lillie,
University of Chicago,
T. H. Morgan,
Columbia University,
G. H. Parker,
Harvard University,
J. Reighard,
University of Michigan,
H. M. Smith,
U. S. Commissioner of Fisheries,
Committee on Zoology of the National Research Council

SCIENTIFIC EVENTS

SUSPENSION OF THE KEW BULLETIN

Publication of the *Kew Bulletin* has been suspended on the ground of shortage of paper. In regard to this *Nature* remarks:

When we see the waste of paper used in Parliamentary Reports, National Service propaganda, and by government departments generally, and place this by the side of the amount required for the continued publication of such a periodical as the *Kew Bulletin*—imperial in its scope and influence—we begin to despair that our state officials will ever possess true standards of value in matters pertaining to science. The subject is dealt with in an article on another page; and all we wish to say here is that we are glad to accord the hospitality of our columns to a contribution intended for the *Kew Bulletin*, and that we earnestly hope action will be taken to secure the continuance of a publication which is more essential now than ever it was.

The article mentioned says:

It must be remembered that Kew is the central institution of a great system of smaller institutes established in every region of the empire, and that these institutes exist to further the material prosperity of the countries in which they are situated. The principal sources of wealth in most of our foreign possessions consist for the most part of vegetable products, and it is difficult to overrate the importance of keeping the botanical stations, remote as they mostly are from the main channels of current scientific work, continually informed on relevant matters which from time to time reach the great clearing-house at Kew. It must be evident to everyone that any action which tends to lower the efficiency of these institutes of economic botany must operate in a manner detrimental to the material interests of the country or countries thus affected. It is difficult to believe that either the India Office or the Colonial Office, which are both concerned with the functions that only Kew is in a position effectively to discharge, can have been consulted in the matter, or, if they had been so consulted, that they could have approved of a step so unsound alike on economic and financial grounds.

Furthermore, it should not be forgotten that Kew receives a good deal from other countries by way of exchange for the *Bulletin*, which it is now proposed to suspend. We understand that enemy countries, although their colonial interests are as nothing compared with our own, have, nevertheless, not seen fit to interfere with the continued publication of their own corresponding journals.

In fact, the same official lack of appreciation of the importance of scientific inquiry and research which was a matter of common knowledge amongst our competitors before the war still continues to sap the foundations of our recognized claims to our foreign possessions, which should largely rest

on the encouragement of their material development on sound economic, and therefore on scientific, lines.

It is earnestly to be hoped that the action apparently taken may be reconsidered before we allow ourselves, as a colonial power, to be made ridiculous, and as a business people to stand committed to the policy of penny wise and pound foolish.

Unless we learn in time the lessons which this war is enforcing on every side, namely, that the way of prosperity in the future lies in promoting scientific knowledge and in utilizing the results of scientific investigation, it will make but little difference in the long run whether we win the war or not. For we should assuredly lose in the far more serious conflict that is certain to follow it, a conflict in which the claim for superiority will be inexorably decided against any nation which refuses to take full advantage of that knowledge which is power in a sense far more real than ever before.

DAYLIGHT SAVING

RESOLUTIONS in reference to daylight saving were, on May 23, adopted by the American Philosophical Society as follows:

Resolved, That The American Philosophical Society, convened in special meeting for this purpose, memorialize the Congress of the United States urging the early enactment of the identical bills, House No. 2609 and Senate No. 1854, entitled respectively "A bill to save daylight and to provide standard time for the United States."

Resolved, That the members of the American Philosophical Society urge their respective senators and representatives to take early and affirmative action on these bills, and that the society address the President, asking his approval of them.

Resolved, That the members of the American Philosophical Society urge their respective state legislatures to pass resolutions favoring these bills, as the Pennsylvania Legislature has recently done, and that they furtner urge commercial, financial, agricultural and engineering societies in their respective localities to memorialize Congress for the early enactment of these bills.

Mr. Arthur H. Lea, in moving the adoption of the above resolutions, said in part:

In his *Autobiography,* Benjamin Franklin wrote: "In walking through the Strand and Fleet Street one morning at seven o'clock I observed there was not one shop open, though it had been daylight and the sun up above three hours; the inhabitants of London chusing voluntarily to live much by candle light, and sleep by sunlight, and yet often complain, a little absurdly, of the duty on candles and the high price of tallow." (Bigelow edition, Philadelphia, 1868, pp. 291–92.)

The founder of this society was the first to present the idea of Daylight Saving, but his suggestion has been neglected for one hundred and fifty years. Men can not and will not individually alter their habits of rising and going to bed, but collectively they can do so wth no inconvenience. Traveling eastward or westward we alter our watches one hour at certain places and immediately forget the change and adapt ourselves to the new time. By federal legislation we can do the same and as easily throughout the entire country.

The bills aforesaid would legally establish the standard time zones adopted by the railroads in 1883, which innovation was then recognized as an immense convenience. They would also cover any legal questions by providing that standard time is to govern common carriers, government officers and persons subject to the jurisdiction of the United States, in their acts and legal relations, rights and contracts. Furthermore, after establishing standard time, these bill provide for advancing it in five zones, respectively, by one hour at 2 A.M. on the last Sunday in April of each year, and for retarding it by one hour at 2 A.M. on the last Sunday in September. The only amendment necessary, now that April, 1917, is past, is to provide that for this year the advancement shall take effect at the earliest date, to be specified, after approval of the Act of Congress.

All the belligerent European nations, except Russia, have adopted Daylight Saving as a war measure for efficiency and economy, and adjacent neutral nations, such as Norway, Sweden, Denmark and Holland, have done likewise. These European nations now follow time standards 6 and 7 hours ahead of ours, and therefore their business day is practically over before ours begins. Stock exchanges in London and Paris now close one hour before our Exchanges open, and the Continental European stock exchanges close two hours before our opening. Stock exchange transactions within the same day would be facilitated by our advancing our time, and the same would be true of ordinary commercial and financial transactions across the ocean.

THE SMITHSONIAN STATION FOR THE STUDY OF SOLAR RADIATION

The Smithsonian Institution has established a station for the study of solar radiation on Hump Mountain, two miles from the town of Elk Park, North Carolina, at an altitude of about 4,800 feet. Dr. Charles E. Abbot, who has just returned from Hump Mountain, reports that the main and auxiliary buildings are ready and that the equipment is nearly all hauled up to the station. With the assistance of Mr. A. F. Moore, of Los Angeles, who is to be the local director, Dr. Abbot unpacked and set up most of the observing apparatus, all of which he expects will be ready for use in a few days.

Assisting Mr. Moore, is Mr. Leonard H. Abbot, of Worcester, Mass., and associated with Mr. Moore for some weeks will be Mr. L. B. Aldrich, of the Astrophysical Observatory, who left Washington recently for North Carolina to represent Dr. Abbot. The expedition is expected to continue at Hump Mountain for a year, or longer if conditions warrant. Its purpose is to observe variations of the sun's output of radiation, such as have been discovered by the Smithsonian Astrophysical Observatory and recorded heretofore at its station located on Mount Wilson, in California. It is hoped that the cooperative measurements of the new Smithsonian station in North Carolina and the station on Mount Wilson will promote weather forecasting.

The data needed for such forecasting is secured from measurements of the sun's variation made with the bolometer, invented by Dr. Samuel P. Langley, late secretary of the Smithsonian Institution, taken at observing stations located in different parts of the world. After comparing and correcting these readings registered by the sun's rays, they are referred to standardized tables and the corresponding changes in the temperature of the earth's surface calculated in advance for different localities.

In a pamphlet on this subject recently published by the Smithsonian Institution, the author, Dr. H. Helm Clayton, of the Argentine Meteorological Service, states:

Two important conclusions are derived from this study: (1) That there is an intimate relation between solar changes and meteorological changes of short period, and that measurements of solar radiation like those made by Dr. Abbot and his associates have the greatest importance for meteorology. (2) That there is a class of meteorological changes which have their origin in equatorial regions and by a transference of air, probably in the upper layers, are felt within a few days in higher latitudes. These changes are the complement of the complex meteorological drift which goes from west to east in temperate latitudes with a component of motion from pole to equator in both hemispheres.

THE AQUARIUM OF THE CALIFORNIA ACADEMY OF SCIENCES

By the will of Mr. Ignatz Steinhart, recently deceased, the California Academy of Sciences will receive the sum of $250,000 for an aquarium building to be erected in Golden Gate Park adjacent to or adjoining the buildings or museum of the Academy of Sciences. According to the terms of the will the aquarium is to be known as the Steinhart Aquarium, to be under the management, superintendence and control of the California Academy of Sciences, and the expense of maintenance to be met by the city of San Francisco.

At a recent election a charter amendment was adopted which directs the Board of Supervisors of the city of San Francisco to include each year in their annual budget an item of *not less* than $20,000 for aquarium maintenance.

Mr. Steinhart made many bequests to charitable and educational institutions, the total amount disposed of being about $3,000,000.

SCIENTIFIC NOTES AND NEWS

Among the degrees conferred at the commencement at Princeton University were the doctorate of laws on Dr. George E. Hale, chairman of the National Research Council, and the degree of doctor of science on Dr. Charles H. Mayo, retiring president of the American Medical Association, and Theobald Smith, director of the department of animal pathology of the Rockefeller Institute for Medical Research.

THE degree of Sc.D has been conferred by Union College on William Pitt Mason, professor of chemistry in the Rensselaer Polytechnic Institute.

MR. ORVILLE WRIGHT was awarded the honorary degree of doctor of science at the graduation exercises of the University of Cincinnati.

LEHIGH UNIVERSITY has conferred its doctorate of laws on Wallace C. Reddick, president of the North Carolina College of Agriculture, who gave the commencement address.

AT the formal opening of the American Red Cross Hospital of Paris, on May 31, President Poincaré bestowed the cross of the Legion of Honor on Dr. Joseph A. Blake, surgeon-in-chief of the hospital, and thanked him in the name of the republic for his valuable services during the war.

PROFESSOR HALLER has been elected honorary president of the newly organized French Society of Industrial Chemistry.

GEORGE B. WISLOCKI has been appointed to take charge of the laboratory of surgical research in the Harvard Medical School.

THE California State Board of Health has appointed Professor Charles A. Kofoid, professor of zoology, University of California, as consulting biologist, and Assistant Professor W. W. Cort, associate biologist, and has made provision for the establishment of a biological laboratory for protozoological and helminthological work in conjunction with their Bureau of Communicable Diseases. Two assistants will be appointed in the laboratory.

THE board of trustees of the Leo M. Levi Memorial Hospital, Hot Springs, Ark., announces the founding of a department of medical research to be maintained in connection with the hospital. Dr. Geo. L. Hoffman, formerly assistant to Professor W. Kolle, past director of the Institut zur Erforschung der Infektionskrankheiten in Bern, has been appointed director of the newly founded department, and will assume charge on July first.

MR. PAGE, the United States Ambassador, attended the recent annual meeting of the Royal Geographical Society of Great Britain and presented to Mr. G. G. Chisholm the medal awarded to him by the American Geographical Society. Mr. Chisholm is lecturer in geography at the University of Edinburgh, secretary of the Royal Scottish Geographical Society, and author of commercial and school geographies. Mr. Page, in handing the medal to him, said he had richly earned the recognition of his countrymen for the painstaking character and conscientious thoroughness of his work. Mr. Douglas W. Freshfield, the president, presented the Royal medals and other awards that have already been announced in SCIENCE.

As reported in last week's SCIENCE, Dr. Arthur Dean Bevan, of Chicago, was elected president at the recent meeting of the New York Medical Association. The following officers were also elected: *First Vice-president,* Dr. Edward H. Bradford, of Boston; *Second Vice-president,* Dr. John McMullin, U. S. Public Health Service; *Third Vice-president,* Dr. Lawrence Litchfield, of Pittsburgh; *Secretary,* Dr. Alexander C. Craig, of Chicago; *Treasurer,* Dr. William Allen Pusey, of Chicago; *Chairman of the House of Delegates,* Dr. Hubert Work, of Pueblo, Colo.; *Vice-chairman,* Dr. Dwight H. Murray, of Syracuse, N. Y.; *Trustees,* Dr. Philip Marvel, of Atlantic City; Dr. W. T. Sarles, of Sparta, Wis.; Dr. Bert Ellis, of California, and Dr. Wendell C. Phillips, of New York City. Chicago has been chosen as the place of meeting for 1918.

THE faculty of the Agricultural and Mechanical College of Texas recently appointed a committee on National Defense to cooperate with the Council of National Defense and the State Council on National Defense, consisting of the following members: Dr. W. B. Bizzell, *chairman;* Colonel Clarence Ousley, Mr. H. M. Eliot, Dr. Charles Puryear, Dr. O. M. Ball, Mr. B. Youngblood, Dr. E. P. Humbert.

J. E. TODD, formerly professor of geology in the University of South Dakota and for the last ten years occupying a similar position in Kansas University, has recently been retired on half pay. He hopes to continue research

work, including a report on the history of Kansas during the Glacial Period, which is nearly ready for publication by the Kansas University Geological Survey. He celebrates this year the fiftieth anniversary of his graduation at Oberlin College, O.

It was incorrectly stated in the issue of Science of June 8 that Dr. George Dock, of St. Louis, had received the French war cross for service in France. The item, which in some way became distorted in the daily and medical press, should have referred to Dr. Dock's son, George Dock, Jr., a Dartmouth graduate of 1916, who has been in the American Ambulance for more than a year and was for many months in the vicinity of Verdun. There, in the words of the citation, "s'est distingué . . . par son mépris du danger et son entrain remarquable. Les 18 Septembre et 28 Decembre, 1916, s'est depensé pour des evacuations difficiles et particulièrement pénibles sur des routes sans cesse bombardées."

Dr. Alexander Lambert, of New York, has been ordered to France as medical adviser to the War Relief Commission of the Red Cross during the war. Dr. Tom A. Williams, of Washington, goes to France at the end of this month to fill an appointment as neurologist in the French Service de Santé.

Mr. George P. Engelhardt, curator of invertebrates, and Mr. Jacob Doll, curator of Lepidoptera in the Brooklyn Museum, have undertaken an expedition to the plateau regions of southwestern Utah and northern Arizona. The objects of the field work will be general, though particular attention will be given to lepidoptera, small mammals and reptiles. The expedition was made possible through the generosity of Mr. B. Preston Clark, of Boston.

The University of Pennsylvania Museum Expedition to study the Eskimos of Bering Straits and of the northern coast of Alaska, has left Seattle, Wash. It is financed by John Wanamaker and headed by Lieutenant Van Valin, who for three years was in the government service as an inspector of schools in Alaska.

At the annual meeting of the Botanical Society of Pennsylvania held on the grounds of Mr. Robert Le Boutillier, Wayne, Pa., on Saturday, May 5, 1917, Dr. C. Stuart Gager gave an address on "The aims and objects of the Brooklyn Botanic Garden."

The annual congress of the Southeastern Union of Scientific Societies was held in London, in the rooms of the Linnean Society, on June 6–9. Dr. William Martin, formerly general secretary of the union, the president, had as the subject of his address "The application of scientific method."

The eighth Halley lecture was delivered at the University of Oxford, on June 12, by Professor Arthur Schuster. The subject was "Terrestrial magnetism: past, present and future."

Sir Alexander R. Binnie, the distinguished English civil engineer, died on May 18, at seventy-eight years of age.

M. Joseph Riban, honorary professor of the faculty of sciences of Paris, known for work on organic and applied chemistry, has died at the age of eighty years.

We learn from the London *Times* that it has been decided to take over a part, at least, of the Victoria and Albert Museum for the accommodation of the Board of Education and their staff. The Imperial Institute, which had been selected for this purpose, is to be devoted to other uses. The Trench Warfare Department, which occupied part of the Board of Education's premises in Whitehall, is to find a place in the building in Millbank of the British-American Tobacco Company, who, upon being informed of the needs of the government, immediately offered to surrender their headquarters on the understanding that other premises should be found for their staff. Arrangements are being made with an hotel to supply the necessary accommodation.

The National Museum has recently received as a gift from Mrs. George W. Vanderbilt the botanical specimens and books of the Biltmore Herbarium, the well-known botanical institution established and maintained for many years by the late George W. Vanderbilt

at Biltmore, North Carolina. During the disastrous floods of last July the Herbarium was largely inundated, suffering a loss of about three fourths of the botanical specimens and injuries to a considerable portion of the library. The uninjured specimens, chiefly phanerogams, number about 25,000, and will be of great value to the National Herbarium in augmenting its representation of southeastern plants. The collection contains, also, a large series of *Cratægus* specimens, including the types of many species described by Mr. C. D. Beadle, curator of the herbarium and an authority in this difficult genus. The library includes complete sets of several important botanical and horticultural publications, as well as many botanical works not hitherto in the National Museum.

UNIVERSITY AND EDUCATIONAL NEWS

A COMMITTEE of the Massachusetts Medical Society, consisting of Samuel B. Woodward, chairman, Dr. E. H. Bradford, Dr. Edward C. Streeter, Dr. Arthur N. Broughton, Dr. Peer P. Johnson and Dr. Philemon E. Truesdale, has been appointed to further the establishment of a department of military medicine, surgery and hygiene in the Harvard Medical School. It is proposed to raise an endowment fund of $100,000.

THE financial board of the University of Cambridge has issued a report on the estimated income and expenditure for the year 1917. Although the common university fund, which is derived from assessments of colleges, is slightly greater than in 1913, the university chest, which is largely derived from capitation fees, examination fees, etc., has fallen from £53,400 to £23,900. The board estimates that the normal expenditure on the university chest will be £36,200, as against an estimated income of £20,400, leaving a deficiency of £15,800. Towards this they are able to provide the sum of £12,700, leaving a deficiency of £3,100.

THE archeological and ethnological collections of the late Dr. J. William White, of Philadelphia, have been presented to the University Museum by Mrs. White.

AT the University of Virginia Dr. Theodore Hough, acting dean, has been made dean of the medical school; Dr. James A. Wardell, associate professor, has been appointed professor of pharmacology and materia medica, and Dr. John H. Neff, instructor, adjunct professor of genito urinary surgery.

AT Harvard University Earnest A. Hooton has been appointed instructor in anthropology, Clarence E. Kelley and Harlan T. Stetson, instructors in astronomy, William E. Brown, instructor in public health administration, Raymond E. Merwin, associate in Central American archeology, and Willis A. Boughton, assistant director in the chemical laboratory.

ASSOCIATE PROFESSOR W. M. CARRUTH, of the department of mathematics at Hamilton College, has been promoted to a professorship.

DISCUSSION AND CORRESPONDENCE

AN INSTITUTE FOR THE HISTORY OF SCIENCE

TO THE EDITOR OF SCIENCE: Referring to the proposal of an institute for the history of science and civilization, as outlined in a recent issue of SCIENCE,[1] the attention of all interested in this project is invited to the fact that the resources of precisely such an institution as has been proposed are indispensable to the full performance of its duties by the United States Patent Office, and to the fact that the resources of this office, inadequate as they now are, should in turn be at the disposal of the proposed institute, for the attainment of its separate purposes.

The suggestion is accordingly made that to the published list of important possible activities, there might most advantageously be added a sixth—the facilitation of prompt and reliable judgments upon all questions of novelty arising in connection with the administration of the patent laws, thereby aiding in the placing of the administration of such laws upon a secure scientific foundation. Surely the attainment of this additional purpose would be of sufficient public importance to deserve separate enumeration, and the furtherance of it

[1] SCIENCE, No. 1160, p. 284.

would constitute a most persuasive argument for the location of the new institute in Washington—within reach also of the Smithsonian Institution, the Bureau of Standards, the Bureau of Mines, the Department of Agriculture, the Geological Survey, the Medical Museum, the Carnegie Institution and the Library of Congress.

If any combination of circumstances can lead to united practical efforts toward common or related purposes on the part of those who seek a perfecting of the patent system, and those whose interests as scientists and educators extend beyond all current technical applications, it would seem past doubting that notable results must follow promptly.

In this connection attention is invited to the fact that the Patent Office is now admittedly unable to make an adequate application even of its present resources. The point here made is not that a surplus from the collection of fees is required to be turned over to the federal treasury, while the needs of the office for literature, laboratories, and men remain unprovided for. It is that the accumulation of patent grants has reached to such limits (about one and one quarter million grants), that, in the absence of adequate appropriations for the work of reclassification, the office is *unable to find the needles in its own haystack.* To quote from the current report of the Commissioner of Patents, Thomas Ewing:

> In 1890 there were 189 members of the examining corps, of whom 30 were examiners. The assistant examiners (who make the searches) numbered 159. Each assistant had to report on 251 applications per year.
>
> In 1916 the corps numbered 367, of whom 43 were examiners and 324 assistant examiners. Each assistant must report on 210 applications per year.
>
> The extent of the field of search is fairly represented by the United States patents granted and the available foreign patents. In 1890 there were 443,000 United States patents and 635,000 available foreign patents, making a total of 1,078,000. At the close of 1916 there were more than 1,210,000 United States patents and 1,690,000 available foreign patents, totaling 2,900,000.
>
> From these figures it will appear that the number of applications to be passed upon by each assistant has been reduced since 1890 by seventeen per cent. The number of available patents through which search must be made is now two hundred and forty per cent. of what it was in 1890. The force relative to the work which it has to do is therefore less than fifty per cent. to-day what it was in 1890.
>
> In order that such a situation may be met at all it is absolutely essential that the best method of classification should be adopted, the classification completed and kept up to date. Yet when I laid all of these facts before Congress and pointed out, as indicated in an earlier section of this report, that at the present rate of reclassification now going on it could not be completed under twenty-five years I succeeded in obtaining no relief whatsoever. Every recommendation that I made during the past year has been refused.

If there could be established *in the national capital* an institute devoted to a study of the development of pure and applied science, is it not important that, even though incidentally to other great consequences, there might be created in both the legislative and administrative branches a new appreciation of the work, the responsibilities, and the opportunities, of an existing establishment, charged under the constitution, "to promote the progress of science and the useful arts"? Certainly those who are now engaged upon the performance of this duty are not all insensible of their limitations, nor of the services of stimulation and cooperation which could be rendered by disinterested and competent men of science.

Bert Russell

Washington, D. C.

A CURE FOR SHOCK?

At a meeting of the Massachusetts Medical Society on June twelfth in Boston, Professor Walter B. Cannon, Shattuck lecturer in lieu of Dr. R. P. Strong (although both are now in France), detailed the probable physiology of traumatic and surgical shock, and suggested a possible cure. Dr. Cannon sees the essential primary condition in shock to be the vasomotor trapping of too much of the body's blood by the splanchnic veins—capacious enough to contain all the life-blood of the or-

ganism. On one side are the myriad strongly constricted arterioles and, preventing the blood's escape, the capillaries of the liver intervening between the veins and the vena cava.

Dr. Cannon's plan to restore this essential blood to the systematic circulation, including that of the dying central nervous system, is to inject into the peritoneal cavity a properly adapted solution of some powerful vaso constrictant, preferably pituitrin. The expectation is that the hormone will osmose from the outside of the omenta through the thin connective tissue coverings of the veins and, by forcing the constriction of the latter, impel a liter or more of necessary blood into the badly depressed vital organs.

Dr. Cannon is in France, with his assistant, putting this theory into humane use. The whole world will wish him the best of success.

G. V. N. D.

CAMBRIDGE

SCIENTIFIC BOOKS

The Mosquitoes of North and Central America and the West Indies. By L. O. HOWARD, H. G. DYAR and F. KNAB. (Carnegie Institution of Washington.) Vol. III. 1915. Vol. IV.. 1917.

The final part of this great work has at last been issued, amid general rejoicings from those interested in medical entomology, since it contains a full account of the malaria-organism carrier, *Anopheles*. The two parts containing the descriptive matter and synonymy total 1,064 pages, and the treatment is as full and exact as it could be made. Under each species is a full list of references to literature, followed by copies of the original description and the descriptions of the synonyms, if any. Then comes a detailed new description of the adult insect, and of the early stages when known, followed by a full list of the localities from which specimens have been received or recorded. Finally, there is a discussion of the synonymy and relationships. The yellow-fever mosquito alone takes over sixteen pages. The reader finds before him practically all that is known of the species treated, and the book will stand as a model of exhaustive discussion and clear presentation.

Some difference of opinion will exist regarding the names of some of the species. The most troublesome case is that of the yellow-fever mosquito. This important insect has generally been known as *Stegomyia fasciata,* or simply as *Stegomyia,* which has almost become an English word. The name *fasciata* being preoccupied, the name *Stegomyia calopus* was substituted; but Dyar and Knab regarded *Stegomyia* as part of *Aëdes,* and called the species *Aëdes calopus.* As such it appears in the work reviewed, but a footnote is added, pointing out that *Culex argenteus,* proposed in 1787, is the oldest name. Hence we are to write *Aëdes argenteus.* Mr. F. W. Edwards, of the British Museum, maintains *Stegomyia* as a genus, and according to this plan it will be *Stegomyia argentea* (Poiret). It is admitted that *Stegomyia* is very different from the type of *Aëdes,* and evidently the question whether it should be generically separated is one concerning which there may be legitimate difference of opinion. Under these circumstances, in view of the general usage by medical authorities, it would seem better to recognize *Stegomyia.*

Another sort of difficulty arises from the mistakes of identification which have resulted from the poor descriptions of early authors. Thus the common species described at great length as *Culex territans* Walker, and so referred to in numerous works, is now said by Mr. Edwards, who examined Walker's type, to be actually quite distinct. It takes the name *Culex saxatilis,* and the real *territans* is what has gone as *Culex restuans* of Theobald. The result of this correction will be that when *Culex territans* is referred to, it will be difficult to tell which of the two species is intended, and confusion must follow. Walker's description was quite insufficient for determination, and under these circumstances it would seem proper to sink the name as unrecognizable. The two insects concerned will then stand as *C. saxatilis* and *C. restuans.*

The *Anopheles quadrimaculatus* of authors is also involved in difficulties. It is described

under this name in the book, but at the end of the account the opinion is expressed that Say's *quadrimaculatus* was really the species described as *Anopheles occidentalis*. This is determined from Say's locality, "North-west Territory." Accordingly we are told that *Anopheles guttulatus* Harris should be adopted, although it was published without any description. This seems inadmissible, and we turn to the next available name, *A. annulimanus*, which "is said" to belong here. But after all, the *quadrimaculatus* of authors occurs as far northwest as Wisconsin, and it does not appear perfectly evident that it is not Say's insect. *A. annulimanus* was also from Wisconsin.

The full citation of localities is much to be commended. It might have been still fuller, but for the unfortunate habit of a former curator, of throwing away what he regarded as duplicates. The present reviewer eagerly turned to this mass of information for light on a practical problem in which he is interested. In the course of the war, it will be necessary to establish large camps and hospitals, partly for training purposes, partly for wounded and invalided soldiers, partly, no doubt, eventually for prisoners. It will be desirable to place these camps or hospitals near distributing centers, but also in regions where the climate is favorable and the malaria mosquito is absent. In the presence of *Anopheles*, men carrying malaria organisms in their blood will constitute a menace to other soldiers and to the civilian population. The exact distribution of *Anopheles* accordingly becomes a matter of importance. On mapping the recorded distribution from the new volume, it was found that records were lacking from Quebec, Rhode Island, Vermont, Delaware, Ohio, Alabama, Iowa, Oklahoma, Nebraska, N. Dakota, S. Dakota, Minnesota, Wyoming, Montana and Saskatchewan. Obviously in the majority of these cases the absence of records is due to lack of sufficient collections. Ohio, Delaware, etc., certainly possess the same *Anopheles* as all the surrounding states. There is, however, a real blank on the map, covering Montana, Wyoming, the eastern part of Colorado, Nebraska, the Dakotas, Iowa and Minnesota. It is not to be supposed that *Anopheles* is actually absent over all this area, but it must be relatively scarce, and over a considerable region is probably altogether lacking.

In New Mexico, the southern and Pacific *A. pseudopunctipennis* gets as far north as Las Vegas Hot Springs. In Colorado, *A. quadrimaculatus* comes over from Utah as far as Delta County, on the western slope. This same insect is common eastward, in Illinois, Indiana, Missouri, etc., and it may occur right across the country. More exact investigations, which are planned, may be expected to determine whether this is the case.

In order to form an opinion whether the apparent lack of *Anopheles* in the region just cited was wholly due to the absence of collections of mosquitoes, I listed all the reported species of the states involved. Montana has no less than ten recorded species, Colorado six, North and South Dakota each three, Nebraska two, Iowa seven, Minnesota and Wyoming one each. Evidently collecting is greatly needed in several of these states, and the apparent absence of *Anopheles* requires confirmation. It is to be remarked, however, that if it should prove to be scattered here and there over the western plains and valleys, it will probably be absent in several localities, and often when present so localized that it can readily be exterminated

It is a singular thing that there seems to be an almost total absence of any endemic mosquito fauna in the central arid region. The few species found are mostly widespread, the only partial exceptions being a few *Aëdes*. *A. nigromaculis* is peculiar to the arid western-central regions, south to the Mexican State of Chihuahua. *A. fletcheri* belongs to the prairies of western Canada and adjacent United States. *A. idahoensis* is from Idaho, Montana and Nevada, and *A. aldrichi* so far from Idaho only. There is no series of peculiar forms, such as Dyar found in the mountains of California, or such as occurs in parts of Canada.

The total number of species described from

the region indicated in the title is 398. We may surmise that no less than 500 actually occur.

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NOTES ON METEOROLOGY AND CLIMATOLOGY

PHENOLOGY

PHENOLOGY is the study of the periodic phenomena of plant and animal life in their relation to weather and climate. Phenology is most important in forestry, agriculture, horticulture and ornithology. In spite of the wide application of such data there has been but little phenological observing done in this country. The extent of such work here and abroad is summarized by J. Warren Smith in Monthly Weather Review, Supp. 2, October, 1915, in connection with the remarkably long and extensive records of Thomas Mikesell at Wauseon, Ohio. These Wauseon records began in part in 1869 and are published including 1912; complete data are given concerning 114 kinds of wild plants, 48 forest trees, shrubs and vines, 16 kinds of fruits, 20 field and garden crops (with yields of some), and the temperatures, rainfall, frosts and first and last snows. In parts of Europe similar records though of fewer plants have been taken by many observers in the British Isles for more than 20 years and in Hessen 33 years.[1]. Ihne[2] in charge of the latter has made a map of phenological spring, and also compared the distribution of population with the phenological maps.

The Bureau of Entomology and the Forest Service are studying phenology as an aid in planting and cutting trees and in the control of pests.

Dr. A. D. Hopkins, of the former, has formulated in a general way the law of phenological variation as follows:[3] "The average variation in the dates of a phenological phenomena of a species is in uniform proportion to the variation in the controlling factors of climate." The general average is the only one for drawing reliable conclusions. A variation of 4 days is to be found with a difference of 1° in latitude, 400 feet in altitude, 5° in longitude westward, or 1° F. The longitude variation seems to be connected with the increasing dryness and strength of sunlight for the Central United States, and with the warmth of the Pacific as the west coast is approached. Departures from the theoretical are the result of local factors. Prevailing sunshine, aridity, absence of large bodies of water, warm ocean currents, prevailing warm winds, S., S.E. and S.W. slopes, narrow summits or plateaus of hills and mountains, broad valleys, open forests, barren or sandy and dry soils—these are accelerating; the opposite conditions are retarding. The size of departures are roughly as follows: error in interpretation, 2 days; southern or northern slopes 1 to 4 days, other retarding or accelerating factors, 1 to 4 days, early and late individuals 1 to 8 days, coastal influences 10–14 days.

The results of collection made by the Forest Service of a large amount of phenological data on 72 common trees in the eastern United States is published in Monthly Weather Review, Supp. 2, October, 1915, pp. 5–9 incl., "A Calendar of the Leafing, Flowering and Seeding of the Common Trees of the Eastern United States," by George N. Lamb. The dates are given only for the extreme north and south limits of their ranges. Further cooperation in the collection of such data is desired by the Forest Service.

In agriculture, phenology contributes not only to the control of pests, but also is of use in determining the proper dates for planting certain crops. On the basis of a thorough study of the Hessian fly at one or more control stations in West Virginia, Dr. Hopkins was able to construct a map and table with which if he knew his location and altitude a farmer could plant his winter wheat during a short period immediately after the usual disappearance of the Hessian fly. In the spring, wild plants are used by many to indicate the proper

[1] Quart. Jour. Roy. Meteorological Soc., J. E. Clark—13 common plants, 6 birds, 5 insects, more than 100 stations.

[2] "Arbeiten der Landwirtschaftskammer für das Grosherzogtum Hessen."

[3] "Report on Forest Trees," 1914.

dates for planting. Thus, "when the silver maples begin to put forth their leaves and the catkins appear on the willows and poplars, nature is indicating that the season is right for the planting of such vegetables as lettuce, mustard, onion seeds and onion sets, parsley, the round seeded peas, early Irish potatoes, radishes, spinach and turnips."[4] Ten days later beets, carrots, kohl-rabi and a second sowing of peas can be made.

CLIMATOLOGY OF THE PERUVIAN ANDES

Dr. Isaiah Bowman has devoted one sixth of his recent book, "The Andes of Southern Peru" (336 pp., New York, 1916) to a well-illustrated discussion of the perplexing diversities of Peruvian climates. There are four climatic belts: (1) the wet, eastern lowlands, covered with heavy tropical forest; (2) the wet, windward mountain slopes, with mountain forest extending up to the cold timber line at 10,500 feet, and in protected valleys down to a dry timber line at 3,000 feet; (3) semi-arid mountains, plateaus and basins, covered with grass, moss and alpine plants; (4) the arid coastal zone of irrigated valleys, barren except along valley floors and on the seaward slopes of low coast ranges.

On the wet, windward mountain slopes the belt of heaviest rainfall is between 4,000 and 10,000 feet. Summer is rainiest, for the force of the trade wind by day is greatly increased by virtue of the greater contrast between the highland and lowland temperatures. In the deep, shut-in valleys of the eastern mountains, conditions of marked aridity are found. The local climates of the semi-arid mountains, plateaus and basins depend on altitude, and thus differ primarily in temperature and winds. The chapter on "Meteorological Records from the Peruvian Andes," adds the daily touch to the preceding general discussion of climate. Extensive diagrams, including daily temperature maxima, minima, variability, and daily rainfall show a tropical steadiness, but, withal, sudden weather changes and considerable differences between corresponding seasons of different years. The diagrams taken from thermograph tracings show vividly the effect on the temperature of changes of wind, the passing of clouds or the inception of storms. The Yale Peruvian Expeditions with the National Geographic Society still maintain some meteorological stations in Peru.

The climates of the coast are the most difficult to explain. Widely accepted are the general explanations of the coastal desert of northern Chile and of Peru: that the deserts are there because the normal trade winds blow over the mountains and on descending are warming, drying winds; and that the cold coastal water intensifies the dryness because any winds thence have little tendency to yield rainfall over a warm land. This cold water is an adjunct of the prevailing offshore "trades," for the warm surface water blown out to sea is replaced by cold abysmal water. In southern Peru, Bowman distinguishes five zones from coast to mountains: (*a*) zone of coastal terraces, rain once in many years; (*b*) zone of fog-covered mountains, rain at intervals of 5–10 years; (*c*) zone of desert plains, rain at intervals of many years; (*d*) zone of steep valleys, yearly rains; (*e*) zone of lofty mountains and plateaus, frequent rains in summer months.

The sea-breeze is the most important meteorological feature of the coast. By day the heating of the land on a slope tends to make an up-hill wind; the heating of the land next to cold water tends to make a breeze on-shore. Combined, these two factors make a wind which blows so strongly that shipping operations in the afternoon are hindered or rendered impossible. Its coming at or before noon is uncomfortably boistrous and dusty. On the coast the highest temperature occurs just before the sea-breeze arrives. The coast range, where present, makes this wind rise abruptly several thousand feet, which generally causes fog at 2,000 to 4,000 feet elevation, and in winter some rainfall. Beyond the coast range, however, the air is warmed, and mixed rapidly by convection with the high dry air so that no more condensation occurs until it approaches the western Cordillera. There the topograph-

[4] U. S. Dept. Agric. Weekly News Letter, Mar. 24, 1915.

ically forced ascent of the air again brings it to the condensation point, and at 8,000 feet, rain may come in summer. The rainfall on the windward side of the coast range occurs in winter, for then the land is more nearly the temperature of the water. In summer, even with the sea-breeze twice as strong, the heated land surface warms the ascending air too rapidly for the occurrence of precipitation. As little moisture is lost in summer on the coast range, the relative humidity is higher in the interior, so that as the strong winds drive up the mountains, there is more moisture available for precipitation. With unusual wind frequency from the north, there are heavy coast rains at intervals of four to ten years, for then the cold coast water is replaced by a warmer current.

Throughout Peru, the trade winds are in control: there is the wet windward slope, the semi-arid interior plateau and the arid leeward coast. The extraordinary inner diversity of climate in the eastern mountains is due to the difference in exposure to the trade winds, and to the differences in altitude. The contrasts within the desert coast region are the result of the effect of the topography on the daily sea-breezes of varying strength blowing off the cold Humboldt current.

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SPECIAL ARTICLES

THE DISTRIBUTION OF ENDEMIC SPECIES IN NEW ZEALAND

THE flora of New Zealand is so exceptionally rich in endemic forms that its study promises interesting results if taken up under the modern conceptions concerning the origin of species. It embraces among the angiosperms 902 endemics confined to New Zealand proper against 399 forms of wider distribution, 98 of which are confined to New Zealand and outlying islands. This consideration has induced J. C. Willis to make a statistical study of this flora[1] and to compare it with the results deduced from his similar treatment of the endemic forms of Ceylon.[2]

Willis has proposed a new principle for explaining the distribution of plants in general, which is that "the area occupied by any given species (taken in groups of twenty or so) at any given time in any given country in which there occur no well-marked barriers depends upon the age of that species in that country." This proposition he calls his hypothesis of "age and area." It is intended to convey the idea that adaptation, although it may be of use in determining the frequency of a species within its area, is not in general a factor of wider operation. No results show in the figures which can be attributed to it. Exceptional instances, where this seems to be the case, are almost always the result of changes in environic conditions, made by man, and it is a well-known fact that such rapidly spreading forms invade a country along its roads and railroads, occupying chiefly waste fields and stirred-up soil.

If, however, we leave these out of consideration and concern ourselves only with ordinary wild species, statistical study seems the only means to get average and reliable results. Taken in small groups of, *e. g.*, 10–20 species these statistical results prove to be the same everywhere and in all the larger families. A general cause must govern this phenomenon, a cause which is, at any rate, independent of morphological and biological qualities.

New Zealand is very convenient for determining the area of its species, for the islands are spread out in a long curve running in general north and south for about 1,080 miles, with an average breadth of 100. Therefore longitudinal range can simply be substituted for area and this can be determined by dividing the country by transverse lines at every twenty miles. Moreover, it consists chiefly of two parts: North Island and South Island, which do not show any essential barriers to the spreading of plants, but are separated by a channel broad enough not to be passed by

[1] Dr. J. C. Willis, "The Distribution of Species in New Zealand," *Annals of Botany*, Vol. 30, No. 119, July, 1916.

[2] See the review in SCIENCE, N. S., Vol. 43, No. 1118, pp. 785–787, June, 1916.

species under average conditions. It is assumed that the forms, common to both islands, arrived or originated there before this separation arose.

On any theory some endemic species will be older and others younger. The first may now occupy the whole country, but the latter only parts and the youngest even only small parts of it. Climate and environmental conditions are so uniform throughout the islands that on the theory of natural selection no part of them has a greater chance of producing endemics than others and an equal distribution should be expected. The actual facts, however, contradict this conclusion and show that the endemics with a small distribution are heaped up in the center of the country, whereas toward the north and south they become regularly rarer. The endemics found in the extreme ends are almost only those which occupy the whole or a great part of the range.

This most interesting law of distribution is proven by a series of tables, which elucidate it from different sides and by means of different statistical arrangements. It clearly points to some cause which is independent of the uniform climatic conditions, and also of the special adaptability of the species. It holds for the species of the families and larger general as well as for the whole flora, and for those occurring also outside of the islands as well as for those confined to them. In other words, it governs the distribution of the forms, which originally reached New Zealand from elsewhere and first populated it, as well as that of the native types.

The explanation proposed is this: New Zealand is separated from the nearest land area of important size by an immense stretch of water, and so it is evident that few species can have arrived there in recent times, apart from the influence of man. The species of foreign origin, *i. e.*, of wider distribution, or the "wides" as Willis calls them in opposition to the endemics, must therefore mostly be very old and widely spread all over the islands. This latter fact is borne out by the statistical tables. Now the soundings show, that the shallowest water approaches New Zealand towards the center of the chain of islands. On the view that this place was its last connection with a larger continent, sunk beneath the sea in geological times, we may assume it to be the point from which the spreading of the main part of its present angiospermous flora has begun.

As the wides spread slowly from this center toward the extreme northern and southern parts they must have produced new forms from time to time. The oldest of these may have spread along with them, and now occupy the whole area. The younger forms, however, did not find, as yet, the time to do so; they must still be local forms. About three quarters of the wides, but only one third of the endemics are now found to occupy more than half the length of the chain of islands and this fact shows clearly that the endemics are not better adapted for distribution in New Zealand than the wides.

On the other hand, there are only 30 wides of very local occurrence, *i. e.*, occupying less than 160 miles or 1/6 part of the whole length (1,000 miles), whereas about one third of all the endemics or 296 species are in this condition. It is obvious that for some reason or other the wides could spread, whilst the endemics could not. No theory of adaptation can explain this phenomenon, but it is very simply understood on the ground of Willis's law that the local species are the youngest, and have not, as yet, had the time to secure a wider dispersal on the islands.

I must refrain from dealing with the contents of all the twelve tables and with the discussions of their results. But from the facts adduced it seems evident that the theory of natural selection can not explain the distribution of the angiospermous species of New Zealand, and that this distribution clearly points to some general cause, which must be the same for all families and all arbitrarily chosen groups of plants as well as for the flora of all different countries. The theory of "age and area" seems the only one broad enough to comply with these requirements.

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